

CLAIMS

1. A method of forming a resistive film on a surface of a sample comprising the steps of:

5       rotating the sample at a rotational speed with the sample being held in a substantial horizontal situation;

      dropping a liquid film material on the sample surface while the sample is being rotated, to form a resistive film thereon; and

10      dropping a solvent which solves the resistive film formed on the sample surface while the sample is being rotated at a rotational speed, thereby dissolving a part of the resistive film to obtain the resistive film having a desired level of thickness.

15 2. A method according to Claim 1, wherein the desired level of the thickness of the resistive film is 0.1 nm to 10 nm.

3. A method according to Claim 1 or 2, wherein the resistive film is water-soluble.

20 4. A method according to any one of Claims 1-3, the sample is at least one of a semiconductor wafer, photo mask and reticle mask.

5. An apparatus for forming a resistive film on a surface of a sample comprising:

25      a spin coater which drops a liquid film material on the sample surface while the sample is being rotated at a rotational speed with the sample being held in a substantial horizontal situation, thereby forming a

resistive film on the sample surface; and

a film thickness uniformizing mechanism which makes the thickness of the resistive film formed on the sample surface thin and uniform by dissolving a part of the  
5 resistive film with a solvent.

6. An apparatus according to Claim 5, wherein the film thickness uniformizing mechanism includes a solvent dropping device which drops a solvent dissolving the resistive film while the sample is being rotated.

10 7. An apparatus according to Claim 5 or 6, the sample is at least one of a semiconductor wafer, photo mask and reticle mask.

8. A method of inspecting a surface of a sample comprising the steps of;

15 coating the sample surface with a resistive film having an arbitrarily determined thickness;

dissolving a part of the resistive film, to thereby reduce the thickness of the resistive film to a desired level which is thinner than that of the arbitrarily  
20 determined thickness; and

irradiating a charged particle beam to the sample surface coated with the resistive film, to thereby conduct inspection of the sample surface.

9. A method according to Claim 8, wherein the desired  
25 level of the thickness of the resistive film is 0.1 nm to 10 nm.

10. A method according to Claim 8 or 9, wherein the resistive film is water-soluble.

11. A method according to any one of Claims 8-10, further comprising the step of removing the resistive film from the sample surface by cleaning it with pure water or ultrapure water after the inspection of the sample surface.

5 12. A method according to any one of Claims 8-11, the sample is at least one of a semiconductor wafer, photo mask and reticle mask.

13. A method of manufacturing a semiconductor device comprising the step of:

10 inspecting a semiconductor wafer in the middle of a manufacturing process and/or after completion of the manufacturing process by a surface inspection method according to Claim 12.

14. A system for inspecting a surface of a sample  
15 comprising:

a surface flattening mechanism for flattening the sample surface;

20 a resistive film coating mechanism for coating a resistive film on the sample surface after the surface is flattened by the surface flattening mechanism, the resistive film having an arbitrarily determined thickness, and then dissolving a part of the resistive film in a solvent, to thereby reduce the thickness of the resistive film to a desired level;

25 an inspection mechanism for emitting a charged particle beam to the sample surface having the resistive film coated thereon, to thereby conduct inspection of the sample surface; and

a conveyor mechanism for conveying the sample between the mechanisms.

15. A system according to Claim 14, further comprising a cleaning mechanism and a sample drying mechanism so that 5 the sample in a clean and dry state is introduced into and removed from the surface inspection apparatus, wherein the surface flattening mechanism, the resistive film coating mechanism, the inspection mechanism, the cleaning mechanism and the sample drying mechanism are disposed so as to 10 surround the conveyor mechanism.

16. A system according to Claim 14 or 15, the sample is at least one of a semiconductor wafer, photo mask and reticle mask.

17. A method of manufacturing a semiconductor device 15 comprising the step of:

inspecting a semiconductor wafer in the middle of a manufacturing process and/or after completion of the manufacturing process using a surface inspection system according to Claim 16.

20 18. A mechanism for inspecting a surface of a sample, comprising:

an electromagnetic wave irradiation apparatus comprising an electromagnetic wave source, and a device for guiding an electromagnetic wave generated from the 25 electromagnetic wave source onto a sample surface;

a detector for detecting electrons emitted from the sample surface which is irradiated with the electromagnetic wave to output an electric or optical signal; and

a processing unit for processing the electric or optical signal from the detector for evaluation of the sample surface.

19. A mechanism according to Claim 18, wherein the  
5 electromagnetic wave source comprises a source which irradiates an ultraviolet or X-ray laser.
20. A mechanism according to Claim 18, wherein the electromagnetic wave source comprises a source which irradiates an ultraviolet ray or X-ray having a wavelength  
10 of 400 nm or less.

21. A mechanism according to any one of Claims 18-20, further comprising:

an electron beam irradiation apparatus comprising an electron beam source, and a device for guiding an electron  
15 beam generated from the electron beam source onto the sample surface; and

an apparatus for driving one or both of the electromagnetic wave irradiation apparatus and the electron beam irradiation apparatus to irradiate the sample surface  
20 with one or both of the electromagnetic wave or the electron beam.

22. A mechanism according to any one of Claims 18-21, further comprising:

an imaging optical system for guiding the electrons  
25 emitted from the sample surface to the detector.

23. A mechanism according to any one of Claims 18-22, the sample is at least one of a semiconductor wafer, photo mask and reticle mask.

24. A method of manufacturing a semiconductor device comprising the step of:

inspecting a semiconductor wafer in the middle of a manufacturing process and/or after completion of the

5 manufacturing process using a surface inspection mechanism according to Claim 23.

25. A system for inspecting a surface of a sample comprising:

a surface flattening mechanism for flattening the  
10 sample surface;

a resistive film coating mechanism for coating a resistive film on the sample surface after the surface is flattened by the surface flattening mechanism, the resistive film having an arbitrarily determined thickness,  
15 and then dissolving a part of the resistive film in a solvent, to thereby reduce the thickness of the resistive film to a desired level;

a surface inspection mechanism according to any one of Claims 18-22 for conducting inspection of the sample  
20 surface having the resistive film thereon; and

a conveyor mechanism for conveying the sample between the mechanisms.

26. A system according to Claim 25, further comprising a cleaning mechanism and a sample drying mechanism so that  
25 the sample in a clean and dry state is introduced into and removed from the surface inspection apparatus, wherein the surface flattening mechanism, the resistive film coating mechanism, the inspection mechanism, the cleaning mechanism

and the sample drying mechanism are disposed so as to surround the conveyor mechanism.

27. A system for inspecting a surface of a sample comprising:

5           a mechanism for flattening the sample surface; and  
              a surface inspection mechanism according to any one  
of Claims 18-22 for conducting inspection of the sample  
surface which has been flattened.

28. A system for inspecting a surface of a sample  
10 comprising:

              a mechanism for coating a resistive film on the  
sample surface; and

15           a surface inspection mechanism according to any one  
of Claims 18-22 for conducting inspection of the sample  
surface which has been coated with the resistive film.

29. A system according to Claim 26, 27 or 28, the sample  
is at least one of a semiconductor wafer, photo mask and  
reticle mask.

30. A method of manufacturing a semiconductor device  
20 comprising the step of:

              inspecting a semiconductor wafer in the middle of a  
manufacturing process and/or after completion of the  
manufacturing process using a system according to Claim 29.